CLAIMS

1. A kit, comprising:

(a) a DNA molecule comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(2) a first promoter which controls expression of the mutant form of the papovavirus large T antigen; and

(b) a first episome comprising:

(1) the papovavirus origin of replication; and

(2) a coding sequence for a protein or a site for inserting the coding sequence for the protein.

2. The kit of claim 1 wherein the first episome comprises the DNA molecule.

3. The kit of claim 1 wherein the papovavirus large T antigen is an SV40 large T antigen.

4. The kit of claim 1 wherein the papovavirus large T antigen is a BK large T antigen.

5. The kit of claim 1 wherein the papovavirus origin of replication is an SV40 origin of replication.

6. The kit of claim 1 wherein the papovavirus origin of replication is a BK origin of replication.

7. The kit of claim 1 wherein the papovavirus large T antigen is an SV40 large T antigen and wherein the papovavirus origin of replication is an SV40 origin of replication.

8. The kit of claim 1 wherein the papovavirus large T antigen is a BK large T antigen and wherein the papovavirus origin of replication is a BK origin of replication.

9. The kit of claim 1 wherein the mutant form of papovavirus large T antigen is an SV40 large T antigen in which residue 107 is lysine and residue 402 is glutamic acid.

10. The kit of claim 1 wherein the first promoter is an inducible promoter.

11. The kit of claim 1 wherein the first promoter is a metallothionene promoter.

12. The kit of claim 1 wherein the first promoter is a promoter for a developmentally-controlled gene.

13. The kit of claim 1 wherein the first promoter is a promoter for a tissue-specific gene.

14. The kit of claim 1 wherein the first promoter is a promoter for a breast-specific gene.

15. The kit of claim 1 wherein the first promoter is under hormonal control.

16. The kit of claim 1 wherein the protein is a cytokine.

17. The kit of claim 1 wherein the protein is an interleukin.

18. The kit of claim 1 wherein the protein confers susceptibility to a chemotherapeutic agent.

19. The kit of claim 1 wherein the protein is *Herpes simplex* thymidine kinase.

20. The kit of claim 1 wherein the protein is cytosine deaminase.

21. The kit of claim 1 wherein the protein is capable of inducing apoptosis.

22. The kit of claim 1 wherein the protein is an anti-oncogenic protein.

23. The kit of claim 1 wherein the protein is p53.

24. The kit of claim 1 wherein the coding sequence for the protein is in the antisense orientation.

25. The kit of claim 24 wherein the protein is an oncogenic protein.

26. The kit of claim 1 further comprising a mammalian cell which can be transfected with the DNA molecule and the first episome.

27. The kit of claim 26 wherein the first episome comprises the DNA molecule.

28. The kit of claim 1 further comprising a mammalian cell which can be transfected with the first episome, wherein the DNA molecule is integrated into the genome of the cell.

29. The kit of claim 1 further comprising a mammalian cell which comprises the DNA molecule and the first episome.

30. The kit of claim 29 wherein the DNA molecule is integrated into the genome of the mammalian cell.

31. The kit of claim 29 wherein the DNA molecule is a second episome.

32. The kit of claim 29 wherein the first episome comprises the DNA molecule.

33. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a human cell.

34. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a bladder cell.

35. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a breast cell.

36. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a peripheral blood monocyte.

37. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a stem cell.

38. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a tumor cell.

39. The kit of claim 26, 27, 28, 29, 30, 31, or 32 wherein the mammalian cell is a non-tumor cell.

40. The kit of claim 1, 26, 27, 28, 29, 30, 31, or 32 wherein the first episome further comprises a second promoter which controls expression of the protein.

41. The kit of claim 40 wherein the second promoter is an inducible promoter.

42. The kit of claim 40 wherein the second promoter is a metallothionene promoter.

43. The kit of claim 40 wherein the second promoter is a promoter for a developmentally-controlled gene.

44. The kit of claim 40 wherein the second promoter is a promoter for a tissue-specific gene.

45. The kit of claim 40 wherein the second promoter is a promoter for a breast-specific gene.

46. The kit of claim 40 wherein the second promoter is under hormonal control.

47. A kit, comprising:

(a) a mammalian cell;

(b) a DNA molecule comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen, wherein the DNA molecule is integrated into the genome of the mammalian cell; and

(2) a first promoter which controls expression of the mutant form of the papovavirus large T antigen; and

(c) a first episome comprising:

(1) the papovavirus origin of replication; and

(2) a coding sequence for a protein or a site for inserting the coding sequence for the protein; and

(3) a second promoter for controlling expression of the coding sequence for the protein.

48. A kit, comprising:

(a) a mammalian cell; and

(b) an episome comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen;

(2) a promoter which controls expression of the mutant form of the papovavirus large T antigen;

(3) the papovavirus origin of replication; and

(4) a coding sequence for a protein or a site for inserting the coding sequence for the protein.

49. A mammalian cell comprising:

(a) a DNA molecule comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation

in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(2) a first promoter which controls expression of the mutant form of the papovavirus large T antigen; and

(b) a first episome comprising:

(1) a coding sequence for a protein or a site for inserting the coding sequence for the protein; and

(2) the papovavirus origin of replication.

50. The mammalian cell of claim 49 wherein the DNA molecule is integrated into the genome of the mammalian cell.

51. The mammalian cell of claim 49 wherein the DNA molecule is a second episome.

52. The mammalian cell of claim 49 wherein the first episome comprises the DNA molecule.

53. The mammalian cell of claim 49 wherein the papovavirus large T antigen is an SV40 large T antigen.

54. The mammalian cell of claim 49 wherein the papovavirus large T antigen is a BK large T antigen.

55. The mammalian cell of claim 49 wherein the papovavirus origin of replication is an SV40 origin of replication.

56. The mammalian cell of claim 49 wherein the papovavirus origin of replication is a BK origin of replication.

57. The mammalian cell of claim 49 wherein the papovavirus large T antigen is an SV40 large T antigen and wherein the papovavirus origin of replication is an SV40 origin of replication.

58. The mammalian cell of claim 49 wherein the papovavirus large T antigen is a BK large T antigen and wherein the papovavirus origin of replication is a BK origin of replication.

59. The mammalian cell of claim 49 wherein the mutant form of the papovavirus large T antigen is an SV40 large T antigen in which residue 107 is lysine and residue 402 is glutamic acid.

60. The mammalian cell of claim 49 wherein the first promoter is an inducible promoter.

61. The mammalian cell of claim 49 wherein the first promoter is a metallothionene promoter.

62. The mammalian cell of claim 49 wherein the first promoter is a promoter for a developmentally-controlled gene.

63. The mammalian cell of claim 49 wherein the first promoter is a promoter for a tissue-specific gene.

64. The mammalian cell of claim 49 wherein the first promoter is a promoter for a breast-specific gene.

65. The mammalian cell of claim 49 wherein the first promoter is under hormonal control.

66. The mammalian cell of claim 49 wherein the protein is a cytokine.

67. The mammalian cell of claim 49 wherein the protein is an interleukin.

68. The mammalian cell of claim 49 wherein the confers susceptibility to a chemotherapeutic agent.

69. The mammalian cell of claim 49 wherein the protein is *Herpes simplex* thymidine kinase.

70. The mammalian cell of claim 49 wherein the protein is cytosine deaminase.

71. The mammalian cell of claim 49 wherein the protein is capable of inducing apoptosis.

72. The mammalian cell of claim 49 wherein the protein is an anti-oncogenic protein.

73. The mammalian cell of claim 49 wherein the protein is p53.

74. The mammalian cell of claim 49 wherein the coding sequence for the protein is in the antisense orientation.

75. The mammalian cell of claim 74 wherein the protein is an oncogenic protein.

76. The mammalian cell of claim 49, 50, 51, or 52 which is a human cell.

77. The mammalian cell of claim 49, 50, 51, or 52 which is a bladder cell.

78. The mammalian cell of claim 49, 50, 51, or 52 which is a breast cell.

79. The mammalian cell of claim 49, 50, 51, or 52 which is a peripheral blood monocyte.

80. The mammalian cell of claim 49, 50, 51, or 52 which is a stem cell.

81. The mammalian cell of claim 49, 50, 51, or 52 which is a tumor cell.

82. The mammalian cell of claim 49, 50, 51, or 52 which is a non-tumor cell.

83. The mammalian cell of claim 49, 50, 51, or 52 wherein the first episome further comprises a second promoter which controls expression of the coding sequence for the protein.

84. The mammalian cell of claim 83 wherein the second promoter is an inducible promoter.

85. The mammalian cell of claim 83 wherein the second promoter is a metallothionene promoter.

86. The mammalian cell of claim 83 wherein the second promoter is a promoter for a developmentally-controlled gene.

87. The mammalian cell of claim 83 wherein the second promoter is a promoter for a tissue-specific gene.

88. The mammalian cell of claim 83 wherein the second promoter is a promoter for a breast-specific gene.

89. The mammalian cell of claim 83 wherein the second promoter is under hormonal control.

90. A mammalian cell, comprising:

a DNA molecule which comprises:

(a) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and

which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(b) a promoter which controls expression of the mutant form of the papovavirus large T antigen.

91. The mammalian cell of claim 90 wherein the DNA molecule is integrated into the genome of the mammalian cell.

92. The mammalian cell of claim 90 wherein the DNA molecule is an episome.

93. The mammalian cell of claim 90 wherein the papovavirus large T antigen is an SV40 large T antigen.

94. The mammalian cell of claim 90 wherein the papovavirus large T antigen is a BK large T antigen.

95. The mammalian cell of claim 90 wherein the papovavirus origin of replication is an SV40 origin of replication.

96. The mammalian cell of claim 90 wherein the papovavirus origin of replication is a BK origin of replication.

97. The mammalian cell of claim 90 wherein the papovavirus large T antigen is an SV40 large T antigen and wherein the papovavirus origin of replication is an SV40 origin of replication.

98. The mammalian cell of claim 90 wherein the papovavirus large T antigen is a BK large T antigen and wherein the papovavirus origin of replication is a BK origin of replication.

99. The mammalian cell of claim 90 wherein the mutant form of the papovavirus large T antigen is an SV40 large T antigen in which residue 107 is lysine and residue 402 is glutamic acid.

100. The mammalian cell of claim 90 wherein the promoter is an inducible promoter.

101. The mammalian cell of claim 90 wherein the promoter is a metallothionene promoter.

102. The mammalian cell of claim 90 wherein the promoter is a promoter for a developmentally-controlled gene.

103. The mammalian cell of claim 90 wherein the promoter is a promoter for a tissue-specific gene.

104. The mammalian cell of claim 90 wherein the promoter is a promoter for a breast-specific gene.

105. The mammalian cell of claim 90 wherein the promoter is under hormonal control.

106. The mammalian cell of claim 90, 91, or 92 which is a human cell.

107. The mammalian cell of claim 90, 91, or 92 which is a bladder cell.

108. The mammalian cell of claim 90, 91, or 92 which is a breast cell.

109. The mammalian cell of claim 90, 91, or 92 which is a peripheral blood monocyte.

110. The mammalian cell of claim 90, 91, or 92 which is a stem cell.

111. The mammalian cell of claim 90, 91, or 92 which is a tumor cell.

112. The mammalian cell of claim 90, 91, or 92 which is a non-tumor cell.

113. A method, comprising the step of:

culturing a mammalian cell which comprises:

(a) a DNA molecule comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(2) a first promoter which controls expression of the mutant form of the papovavirus large T antigen; and

(b) a first episome comprising:

(1) a coding sequence for a protein; and

(2) the papovavirus origin of replication, wherein the step of culturing is carried out under conditions suitable for expressing the protein.

114. The method of claim 113 wherein the DNA molecule is integrated into the genome of the mammalian cell.

115. The method of claim 113 wherein the DNA molecule is a second episome.

116. The method of claim 113 wherein the first episome comprises the DNA molecule.

117. The method of claim 113 wherein the papovavirus large T antigen is an SV40 large T antigen.

118. The method of claim 113 wherein the papovavirus large T antigen is a BK large T antigen.

119. The method of claim 113 wherein the papovavirus origin of replication is an SV40 origin of replication.

120. The method of claim 113 wherein the papovavirus origin of replication is a BK origin of replication.

121. The method of claim 113 wherein the papovavirus large T antigen is an SV40 large T antigen and wherein the papovavirus origin of replication is an SV40 origin of replication.

122. The method of claim 113 wherein the papovavirus large T antigen is a BK large T antigen and wherein the papovavirus origin of replication is a BK origin of replication.

123. The method of claim 113 wherein the mutant form of papovavirus large T antigen is an SV40 large T antigen in which residue 107 is lysine and residue 402 is glutamic acid.

124. The method of claim 113 wherein the first promoter is an inducible promoter.

125. The method of claim 113 wherein the first promoter is a metallothionene promoter.

126. The method of claim 113 wherein the first promoter is a promoter for a developmentally-controlled gene.

127. The method of claim 113 wherein the first promoter is a promoter for a tissue-specific gene.

128. The method of claim 113 wherein the first promoter is a promoter for a breast-specific gene.

129. The method of claim 113 wherein the first promoter is under hormonal control.

130. The method of claim 113 wherein protein is a cytokine.

131. The method of claim 113 wherein the protein is an interleukin.

132. The method of claim 113 wherein the protein confers susceptibility to a chemotherapeutic agent.

133. The method of claim 113 wherein the protein is *Herpes simplex* thymidine kinase.

134. The method of claim 113 wherein the protein is cytosine deaminase.

135. The method of claim 113 wherein the protein is capable of inducing apoptosis.

136. The method of claim 113 wherein the protein is an anti-oncogenic protein.

137. The method of claim 113 wherein protein is p53.

138. The method of claim 113 wherein the coding sequence for the protein is in the antisense orientation.

139. The method of claim 138 wherein the protein is an oncogenic protein.

140. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a human cell.

141. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a bladder cell.

142. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a breast cell.

143. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a peripheral blood monocyte.

144. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a stem cell.

145. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a tumor cell.

146. The method of claim 113, 114, 115, or 116 wherein the mammalian cell is a non-tumor cell.

147. The method of claim 113, 114, 115, or 116 wherein the first episome further comprises a second promoter which controls expression of the foreign gene.

148. The method of claim 147 wherein the second promoter is an inducible promoter.

149. The method of claim 147 wherein the second promoter is a metallothionene promoter.

150. The method of claim 147 wherein the second promoter is a promoter for a developmentally-controlled gene.

151. The method of claim 147 wherein the second promoter is a promoter for a tissue-specific gene.

152. The method of claim 147 wherein the second promoter is a promoter for a breast-specific gene.

153. The method of claim 147 wherein the second promoter is under hormonal control.

154. A method comprising the step of:

transfecting a mammalian cell with a first episome comprising (a) a coding sequence for a protein and (b) a papovavirus origin of replication, wherein the mammalian cell comprises a DNA molecule which comprises:

(a) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for the papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(b) a first promoter which controls expression of the mutant form of the papovavirus large T antigen.

155. The method of claim 154 wherein the DNA molecule is integrated into the genome of the mammalian cell.

156. The method of claim 154 wherein the DNA molecule is a second episome.

157. The method of claim 154 wherein the papovavirus large T antigen is an SV40 large T antigen.

158. The method of claim 154 wherein the papovavirus large T antigen is a BK large T antigen.

159. The method of claim 154 wherein the papovavirus origin of replication is an SV40 origin of replication.

160. The method of claim 154 wherein the papovavirus origin of replication is a BK origin of replication.

161. The method of claim 154 wherein the papovavirus large T antigen is an SV40 large T antigen and wherein the papovavirus origin of replication is an SV40 origin of replication.

162. The method of claim 154 wherein the papovavirus large T antigen is a BK large T antigen and wherein the papovavirus origin of replication is a BK origin of replication.

163. The method of claim 154 wherein the mutant form of papovavirus large T antigen is an SV40 large T antigen in which residue 107 is lysine and residue 402 is glutamic acid.

164. The method of claim 154 wherein the first promoter is an inducible promoter.

165. The method of claim 154 wherein the first promoter is a metallothionene promoter.

166. The method of claim 154 wherein the first promoter is a promoter for a developmentally-controlled gene.

167. The method of claim 154 wherein the first promoter is a promoter for a tissue-specific gene.

168. The method of claim 154 wherein the first promoter is a promoter for a breast-specific gene.

169. The method of claim 154 wherein the first promoter is under hormonal control.

170. The method of claim 154 wherein protein is a cytokine.

171. The method of claim 154 wherein the protein is an interleukin.

172. The method of claim 154 wherein the protein confers susceptibility to a chemotherapeutic agent.

173. The method of claim 154 wherein the protein is *Herpes simplex* thymidine kinase.

174. The method of claim 154 wherein the protein is cytosine deaminase.

175. The method of claim 154 wherein the protein is capable of inducing apoptosis.

176. The method of claim 154 wherein the protein is an anti-oncogenic protein.

177. The method of claim 154 wherein the protein is p53.

178. The method of claim 157 wherein the coding sequence for the protein is in the antisense orientation.

179. The method of claim 178 wherein the protein is an oncogenic protein.

180. The method of claim 154, 155, or 156 wherein the mammalian cell is a human cell.

181. The method of claim 154, 155, or 156 wherein the mammalian cell is a bladder cell.

182. The method of claim 154, 155, or 156 wherein the mammalian cell is a breast cell.

183. The method of claim 154, 155, or 156 wherein the mammalian cell is a peripheral blood monocyte.

184. The method of claim 154, 155, or 156 wherein the mammalian cell is a stem cell.

185. The method of claim 154, 155, or 156 wherein the mammalian cell is a tumor cell.

186. The method of claim 154, 155, or 156 wherein the mammalian cell is a non-tumor cell.

187. The method of claim 154, 155, or 156 wherein the first episome further comprises a second promoter which controls expression of the foreign gene.

188. The method of claim 187 wherein the second promoter is an inducible promoter.

189. The method of claim 187 wherein the second promoter is a metallothionene promoter.

190. The method of claim 187 wherein the second promoter is a promoter for a developmentally-controlled gene.

191. The method of claim 187 wherein the second promoter is a promoter for a tissue-specific gene.

192. The method of claim 187 wherein the second promoter is a promoter for a breast-specific gene.

193. The method of claim 187 wherein the second promoter is under hormonal control.

194. The method of claim 154 further comprising the step of culturing the mammalian cell under conditions suitable for expressing the coding sequence.

195. The kit of claim 24 wherein the protein controls cell growth.

196. The mammalian cell of claim 74 wherein the protein controls cell growth.

197. The method of claim 138 wherein the protein controls cell growth.

198. The method of claim 178 wherein the protein controls cell growth.

199. A kit, comprising:

(a) a mammalian cell;

(b) a first episome comprising:

(1) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for a papovavirus origin of replication and which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(2) a first promoter which controls expression of the mutant form of the papovavirus large T antigen; and

(c) a second episome comprising:

(1) the papovavirus origin of replication; and

(2) a coding sequence for a protein or a site for inserting the coding sequence for the protein; and

(3) a second promoter which controls expression of the coding sequence for the protein.

200. A method comprising the step of:

transfecting a mammalian cell with an episome comprising:

(a) a coding sequence for a protein;

(b) a papovavirus origin of replication;

(c) a coding sequence for a mutant form of a papovavirus large T antigen which contains a replication-competent binding site for the papovavirus origin of replication and

which is negative for binding to a wild-type p53 gene product due to a mutation in a p53 binding domain of the large T antigen and which is negative for binding to a wild-type retinoblastoma tumor suppressor gene product due to a mutation in an RB binding domain of the large T antigen; and

(d) a promoter which controls expression of the mutant form of the papovavirus large T antigen.